Main Cropping System Experiment (MCSE)

Treatment Key

- T1 Conventional **corn**/soybean/wheat
- T2 No-till **corn**/soybean/wheat
- T3 Reduced Input **corn**/soybean/wheat with cover crop
- T4 Biologically Based **corn**/soybean/wheat with cover crop
- T5 Poplar
- T6 Alfalfa
- T7 Early Successional community
- T8 Mown Grassland (never tilled) community

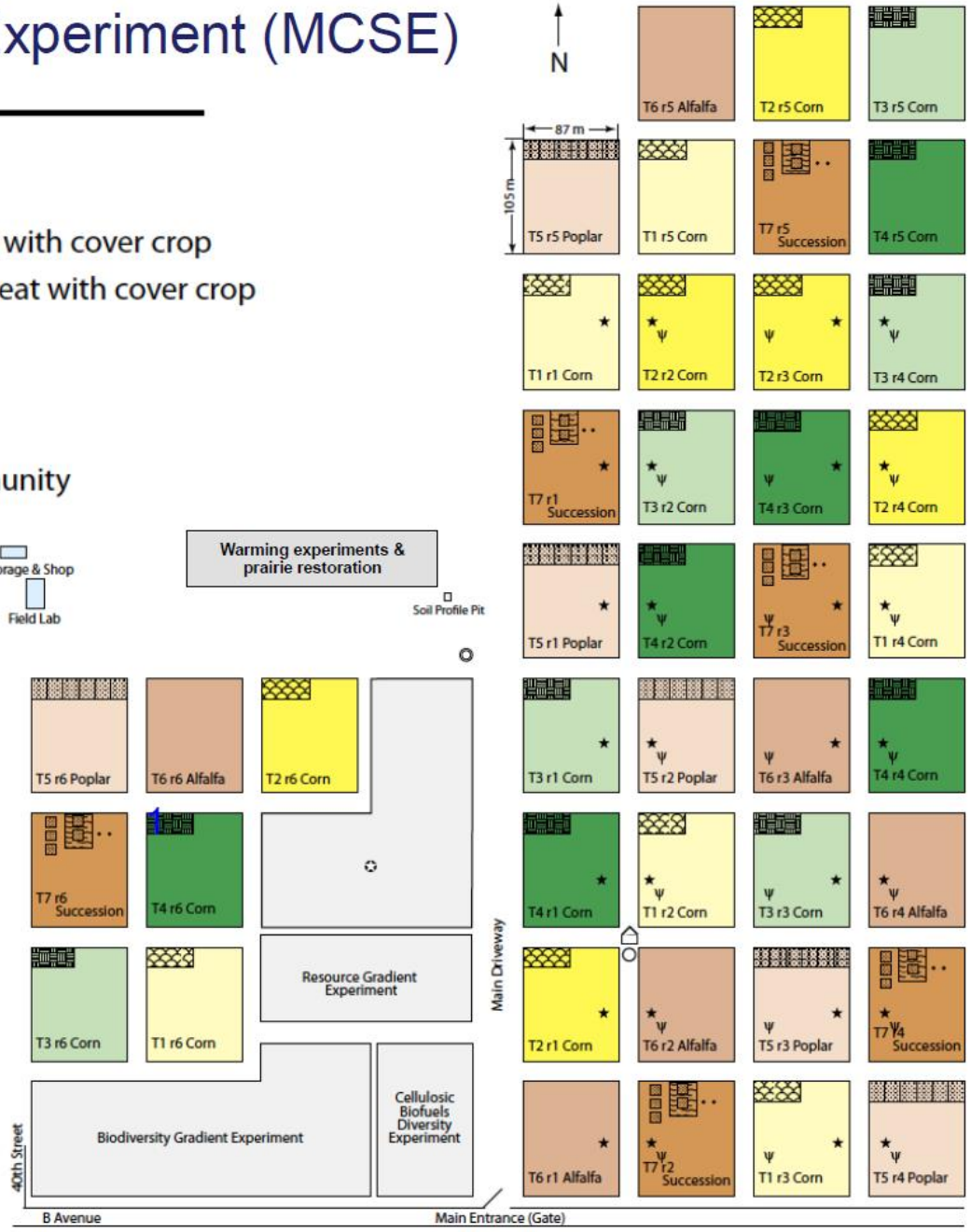
r = replicate number

Microplot Treatment Key

- Nitrogen fertilized
- Tillage (T7)
- Herbicide-free
- Nitrogen fertilized and weed-free

Instrumentation Key

- •• Minirhizotrons
- ★ Trace gas flux chambers
- Ψ Low tension suction lysimeters
- ✪ Weather station & weighing lysimeter
- ⌂ Trace gas shed
- ○ Wireless tower & sun photometer
- ◎ Aphid tower



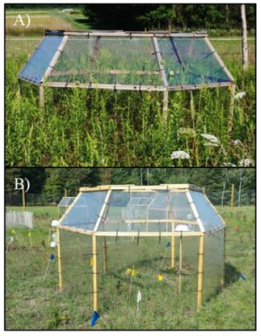
Experimental methods for investigating how climate change will affect…

Meredith Zettlemoyer

1. Prairie restoration success and plant local adaptation.

Jen Lau, Lars Brudvig, Emily Grman

2. Plant-herbivore interactions.

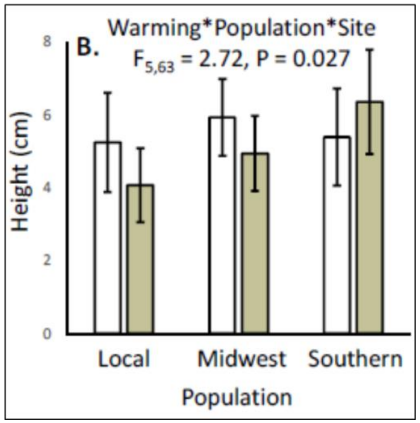


Phoebe Zarnetske, Kileigh Welshofer

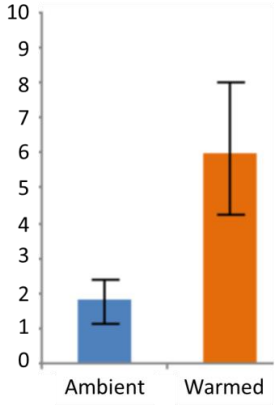
3. Demography and phenology of native, exotic, & invasive species.

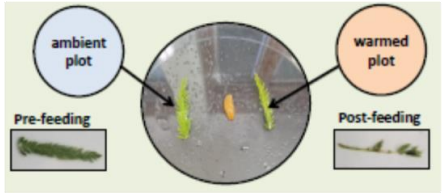
Meredith Zettlemoyer, Jen Lau

Warming increased growth of southern ecotypes, but reduced growth of local and Midwestern ecotypes

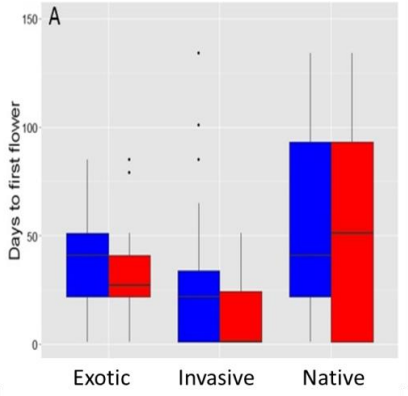


Plants grown in warmer conditions were more susceptible to slug herbivory

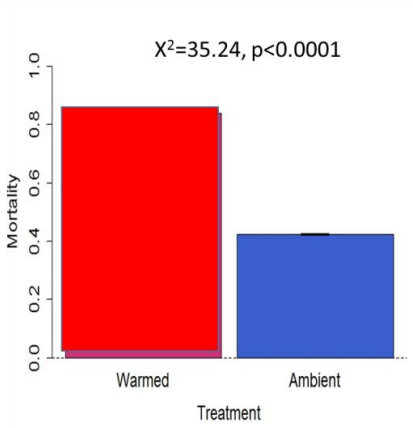




Invasive species dramatically advanced flowering in response to warming; native and exotic species did not



Warming increases mortality of both locally extinct and extant congeners

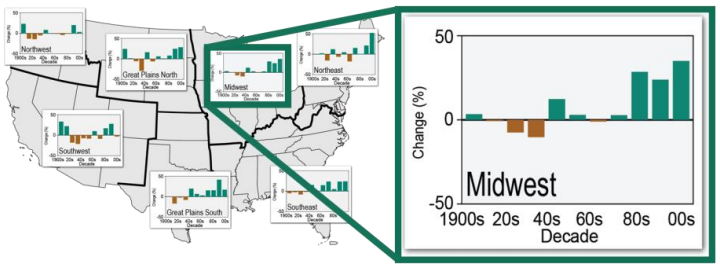


Consequences of Changing Rainfall Patterns on Nitrous Oxide Fluxes in Cropping Systems

Kate Glanville

Extreme Precipitation Events are Increasing

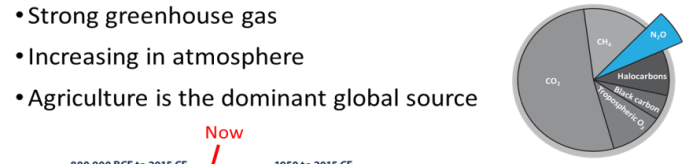
- Changes U.S. decadal precipitation falling in heaviest 1%:

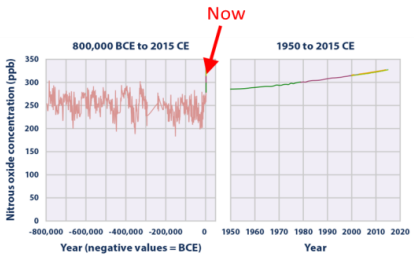


Melillo et al. 2014

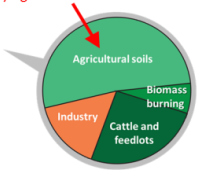
Importance of N_2O

- Dominant ozone-consuming substance in the stratosphere
- Strong greenhouse gas
- Increasing in atmosphere
- Agriculture is the dominant global source



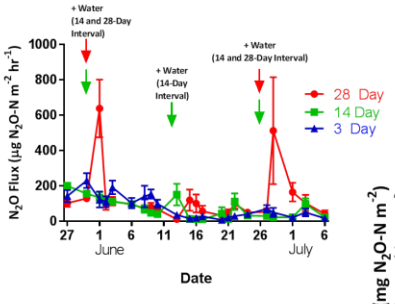


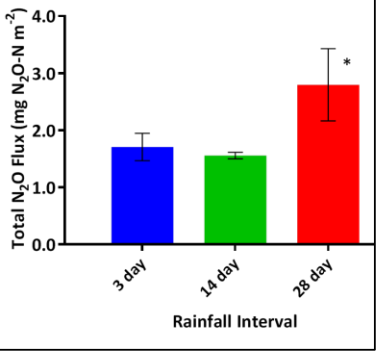
Mainly produced by denitrifying bacteria



Ravishankara et al. 2009; Redrawn from Robertson 2014; EPA 2016

Flux Results (2016) - Corn





Future Work

- Further analyses now underway to

-understand the role of carbon and nitrogen resources

-allocate source of N_2O to denitrifiers and nitrifiers

-how the differences in soil moisture influence fluxes

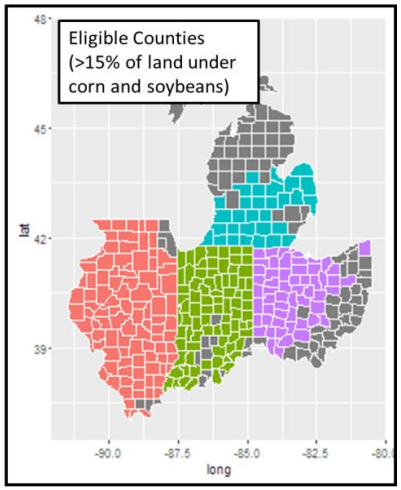
KBS LTER Kellogg Biological Station Long-term Ecological Research
U.S. DEPARTMENT OF ENERGY
Michigan State University AgBioResearch
GREAT LAKES BIOENERGY RESEARCH CENTER

The CMSP Farmer Survey and the MCSE: Initial findings and future directions

Braeden Van Deynze & Sandy Marquart-Pyatt

Survey Design

- Goal: long-term, representative panel of Eastern Corn Belt corn farmers (MI, IN, IL, OH)
- Mail questionnaire sent to 10k+ farmers in Feb 2017
- Topics: information, attitudes, incentives, resources, and management choices at the farm level and of one field planted with corn in 2016
- 3k returned surveys



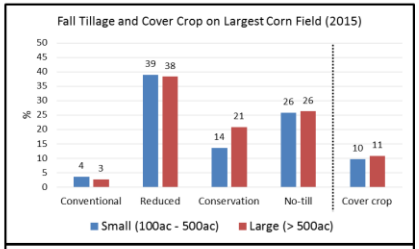
Results: Tillage and Cover Crops

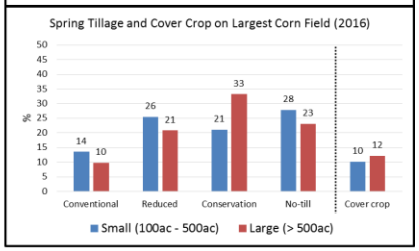
Percent of respondents who used _____ on their largest corn field…

Conventional: < 15% residue remaining
Reduced: 15-30% residue remaining
Conservation: > 30% residue remaining

Implications

- When farmers till in fall, conventional (e.g. moldboard) rarely used
- Larger operations more likely to use conservation tillage (e.g. vertical, ridge, strip) in both fall and spring
  - Likely due to equipment
- Cover cropping still rare
  - But 30% report planting at least sometimes, with about 10% doing so regularly





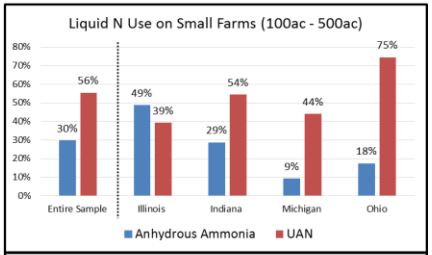
Results: Use of Nitrogen Fertilizer

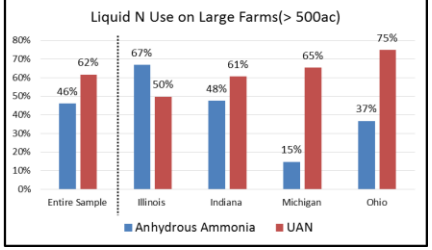
Percent of respondents who used _____ on their largest corn field…

Note: Percentages may not add to 100% due to multiple applications and other unreported N sources

Implications

- Small farms less likely to use anhydrous ammonia
- In Michigan, large farms far more likely to use UAN
- In Illinois, anhydrous ammonia used on more farms than UAN
  - Not so in other states
  - Why? Weather, geography? Social reasons?



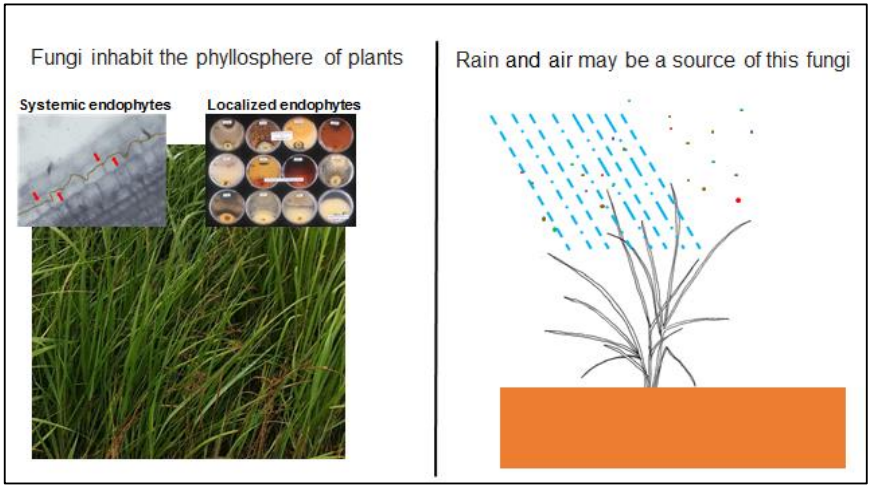


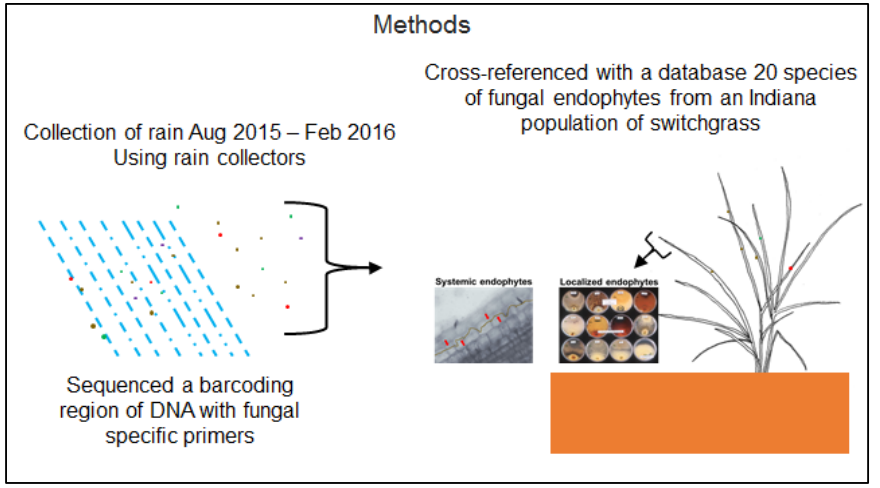
Future Work: Specific and Broader Questions

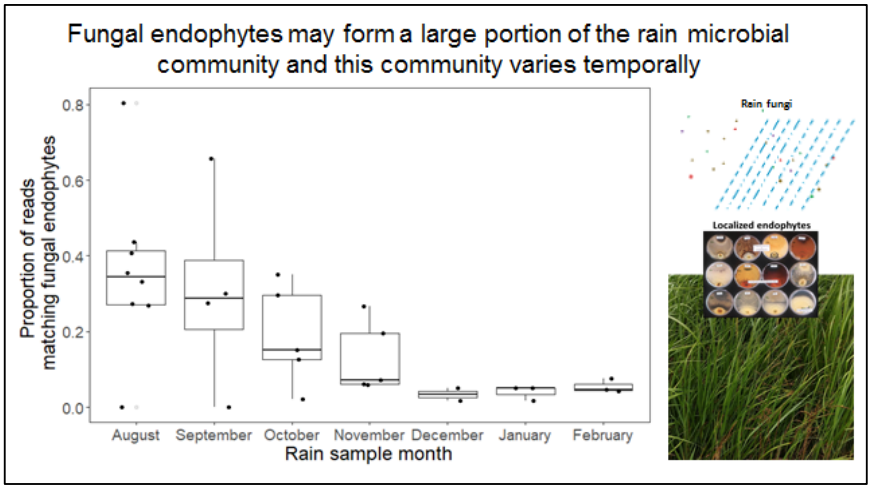
- Toward long-term socioecological research
- Given changing on-farm practice adoption, how do KBS LTER MSCE & GLBRC experimental treatments and farmer agronomic practices continue to inform one another?
- How do climate change and land use change shape farmers' knowledge, attitudes, and practice adoption?
- Moving from understanding to prediction
  - Panel data, surveys, interviews

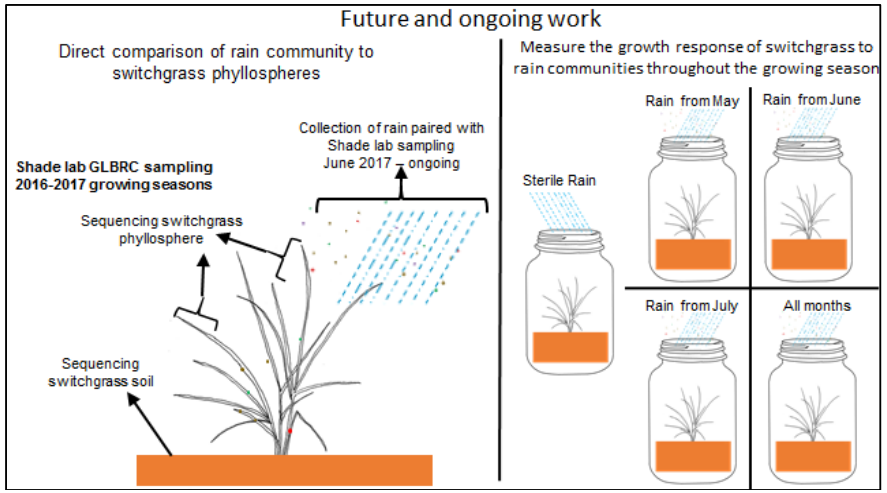
I want to know - have you ever seen the rain fungi?

Lukas Bell-Dereske





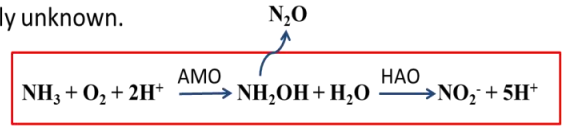




Management intensities and seasons affect the relative contribution of ammonia oxidizing bacteria (AOB) and ammonia oxidizing archaea (AOA) to nitrification

Di Liang

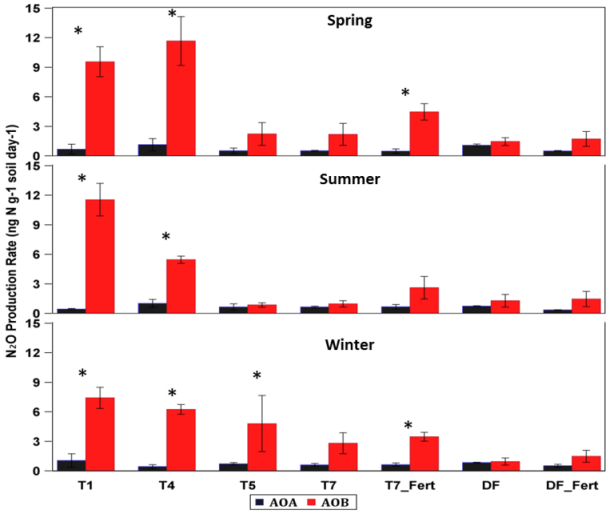
- Nitrification, mainly mediated by AOA and AOB, converts ammonia to nitrite.
- Nitrous oxide (N_2O) is emitted into the atmosphere as a byproduct.
- Relative importance and significance of AOA vs. AOB in nitrification in soil is largely unknown.



Seven ecosystems along a management gradient:

- T1: conventionally managed corn-soybean-wheat rotation
- T4: biologically managed corn-soybean-wheat rotation
- T5: poplar
- T7: early succession
- Fertilized T7: fertilized early succession
- DF: late successional deciduous forest
- Fertilized DF: fertilized late successional deciduous forest

Seasonal contribution of AOA and AOB to N_2O



T1: Conventional Wheat

T4: Biologically Based Wheat

T5: Poplar

T7: Early Succession

T7_Fert: Fertilized Early Succession

DF: Deciduous Forest

DF_Fert: Fertilized Deciduous Forest

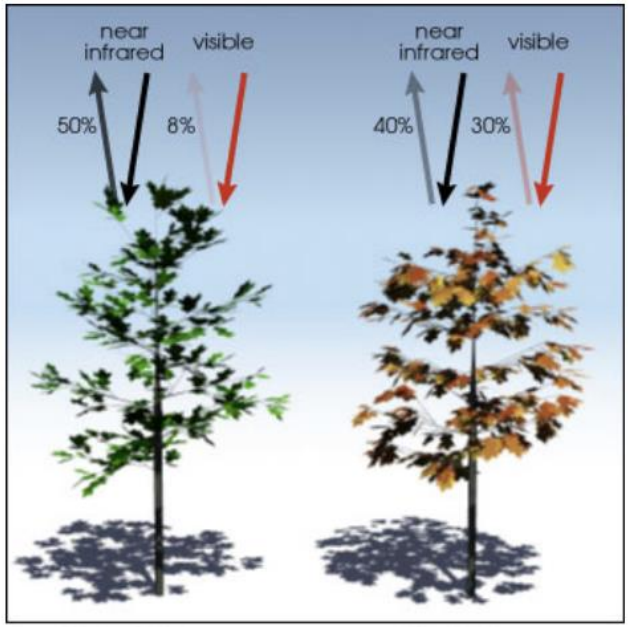
Future Work

- What is the relative contribution of nitrification in N_2O emission compared to other biological processes?
- The importance and mechanisms of AOA and AOB in nitrifier denitrification.

NSF · U.S. Department of Energy · Great Lakes Bioenergy Research Center · KBS LTER Kellogg Biological Station Long-term Ecological Research · Michigan State University AgBioResearch

Remote sensing of vegetation

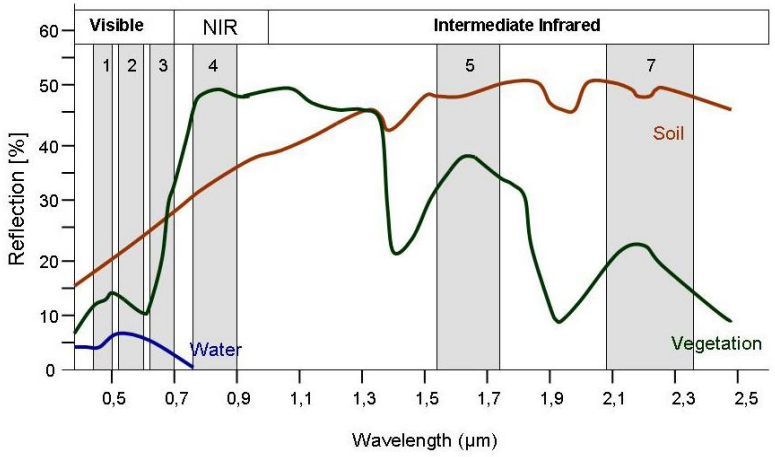
Normalized Difference Vegetation Index (NDVI) is a measure of plant canopy cover and vigor

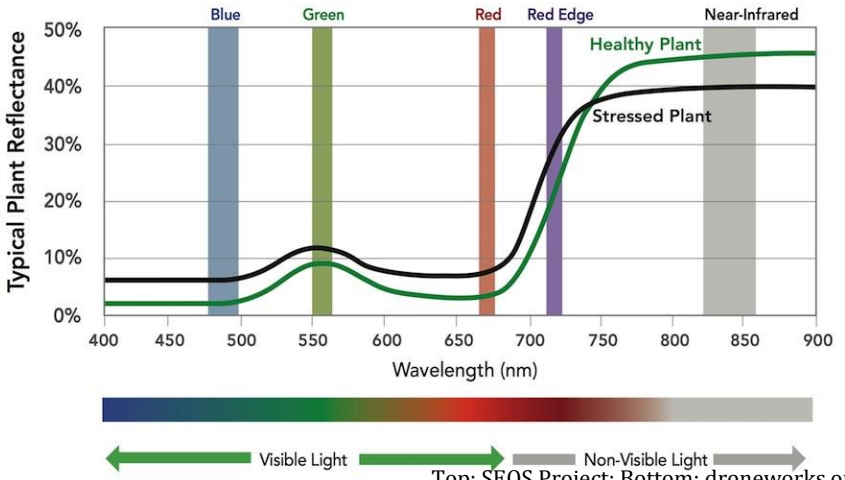


NDVI is calculated from the visible and near-infrared light reflected by vegetation. Healthy vegetation (left) absorbs most of the visible light that hits it, and reflects a large portion of the near-infrared light. Unhealthy or sparse vegetation (right) reflects more visible light and less near-infrared light. The numbers on the figure above are representative of actual values, but real vegetation is much more varied. (Illustration by Robert Simmon).

Source: earthobservatory.nasa.gov

Wavelength bands are designed to distinguish vegetation from bare soil and, with the “red edge” band, to distinguish healthy from unhealthy foliage.



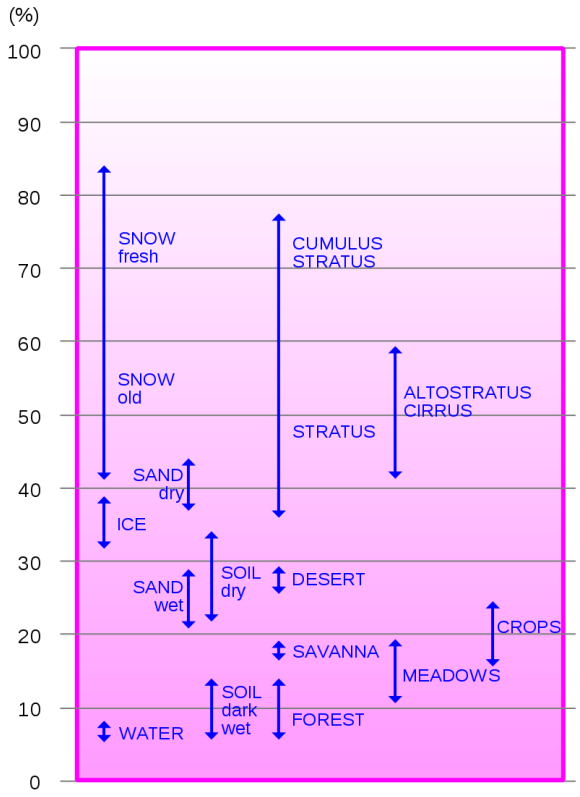


Top: SEOS Project; Bottom: droneworks.org.nz

Remote sensing of energy balance

Land cover changes may entail large changes in albedo

Albedo is defined as the ratio of irradiance reflected to the solar irradiance received by a surface. Radiation that is not reflected is mostly re-radiated as heat and consumed to evaporate water (~1% is used in net primary production.)



Snow cover is most reflective.
Crops tend to be more reflective than forest.

Figure from Wikipedia